Sustainable Land Imaging

Landsat 10 and Beyond

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SLI in FY16 Appropriation

A 3-part program for a sustainable and responsible land imaging program through 2035:

- 1. Landsat 9 (fully Class-B rebuild of Landsat 8) to launch likely late CY2020
 - Low programmatic risk implementation of a proven system with upgrades to bring the whole system to Class B
- 2. Land Imaging Technology and Systems Innovation
 - Hardware, operations, and data management/processing investments to reduce risk in next generation missions
- 3. Landsat 10, Class B full spectrum, to launch ~2027-2028
 - Mission architecture to be informed by the technology investments (2015-), leading to definition ~2020



SLI: NASA Present Status

Landsat-9 Project initiated with FY15 funds

- Directed to NASA's Goddard Space Flight Center (GSFC)
- Project Office established and substantially staffed
- OLI Instrument and L-9 spacecraft procurement actions in work
- TIRS-2 development in progress
- Launch ASAP, likely NET 12/2020 there is sufficient (\$100M) funding authority for FY16

Technology studies underway for L-10 definition and long-term technology infusion

- Detector component development
- Overall instrument size reduction using advanced technologies
- ROSES SLI Technology call released (ROSES 2015 A.47 released 23 Dec 2015: NOI due 22 Jan 16, proposals due 30 Mar 2016)

NASA solicited, selected, and initiated science investigations focused on construction of multi-system fusion data sets ("Multi-Source Land Imaging Science")

- "...[W]e solicit for efficient use and seamless combination with Landsat, of satellite sensor data from international Landsat-type moderate resolution (~30 m ground resolution), multispectral sources on continental to global scales. A primary focus is on developing algorithms and prototyping products for combined use of data from Landsat and Sentinel-2 toward global land monitoring. However, we also welcome proposals combining Landsat with other sources of moderate resolution data, such as IRS and/or CBERS..."
- 7 investigations selected, \$1.3M/year total, 3-year studies

Copernicus data access agreements with EU signed (including all Sentinel-2 data)



Land Imaging Evolution

While recognizing the scientific need for continuity with the 43-year Landsat record, we are seeing new trends & opportunities in land remote sensing

- Evolving user needs for...
 - Improved temporal revisit
 - Additional spectral coverage & resolution
 - Integration with other modalities (lidar, radar)
- Increasing use of "small sat" platforms and distributed architectures
- Increasing number of commercial imaging systems
- Potential synergy with international systems (e.g. Sentinel-2)
- High-performance computing and increased emphasis on information rather than images

Our challenge is to advance the measurement capability, while preserving continuity and constraining program costs



The Road to Landsat-10 and Beyond

- USGS assessing user needs for future land imaging
 - Requirements Capabilities & Analysis for Earth Observations (RCA-EO)
 - Documents land imaging user needs across Federal Agencies
 - Additional input from Landsat Science Team and User Workshops
- NASA Earth Science Technology Office (ESTO) managing technology developments for SLI
 - Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities
 - NASA ROSES proposal opportunity now available
- NASA Space Technology Directorate continuing development of a pathfinder satellite servicing mission [RESTORE-L] with FY16 funding
 - Refuel Landsat-7 (or another U.S. Govt-owned satellite in low-Earth orbit), potentially extending the Landsat-7 lifetime



SLI-Technology Overview

Earth Science Technology Office (ESTO)

 Tasked by the NASA Earth Science Division (ESD) to manage technology developments for the Sustainable Land Imaging (SLI) program

Overall objectives of the SLI-Technology (SLI-T) program

- Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities
- Enable new types of observations that improve temporal, spatial, and spectral resolution capabilities for SLI measurements
- Enable new SLI measurements and architectures which improve operational efficiency and reduce overall program costs of our land imaging capabilities

Example of a Future Technology

Point of Departure - Past

Three 5-degree Field-of-View Offner Spectrometers

Reduced Envelope - Present

Two Dyson spectrometers compactly packaged

Miniature - Future

 Photonic spectrometer utilizing planar waveguide circuits (spectrometer-on-a-chip)



SLI-T Near-Term (FY15) Activities

FY 15 investments addressed areas identified for follow-on work from the earlier SLI Reduced Instrument Envelope Size (RIES) Study

Calibration

- Compact onboard calibration system
- Vicarious calibration system

Performance analysis

- Compact telescope performance
- Hyperspectral imager stray light and optical performance analysis

Detector performance and characterization

- Feasibility of bolometer use for Earth science instruments
- High speed focal plane electronics and detector characterization
- CCD performance characterization



SLI-T FY16 Activities

NASA's Research Opportunities in Space and Earth Sciences (ROSES) solicitations utilized to solicit future instrument systems and subsystem technologies

- Uses Landsat science community for inputs and requirements
- Utilizes grants, cooperative agreements and contracts, as appropriate

Advanced Technology Demonstrations (Systems/Instruments)

- 80% of SLI-T funding for the Landsat-Next mission
- Available for infusion to Landsat-Next, future Earth Venture, or technology demonstration opportunities
- Plan 5-year tasks (1-year base + four 1-year options)

Technology Investments (Subsystems/Components)

- 20% of the SLI-T funding for Landsat-Next+1 mission
- Plan 3-year tasks (1-year base + two 1-year options)

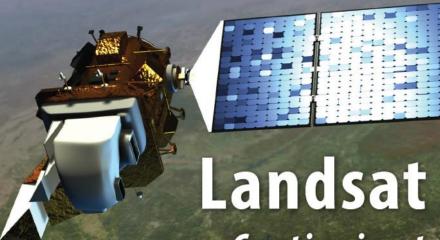
ROSES call released on December 18, 2015

- ROSES15 A.47 NNH15ZDA001N-SLIT
- Proposals due on March 30, 2016
- Selections planned for August 2016









Continuing to Improve Everyday Life http://landsat.gsfc.nasa.gov











